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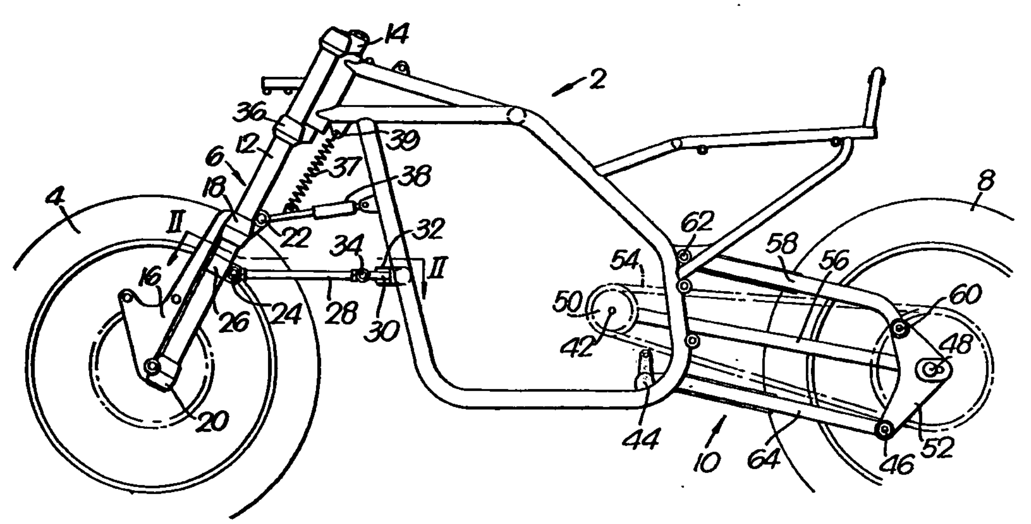
(54) **Motor cycle wheel suspensions**

(57) A motor cycle front wheel suspension assembly comprises stanchions (12) of fixed length which are steerably connected at (14) to the motor cycle frame (2) and upon each of which a slide frame (16) is slidably supported by means of spaced bearings (18, 20), the hub of the front wheel being supported between these slide frames (16). Spring means, e.g. (37), (38), is provided to resist upward movement of the slide frames (16) on the stanchions (12). Bracing rods (28) extend between the stanchions and the frame (2), to allow steering the rods (28) being universally jointed to the stanchions (12), and to opposite ends of a bell crank (30) pivoted at its centre to the frame (2). In another embodiment, each rod (28) is replaced by a hydraulic piston-cylinder device, the two devices being interconnected by hoses. The rear wheel (8) of the motorcycle is connected to the frame (2) by swing arms (56), (58), (64).

Fig. I.



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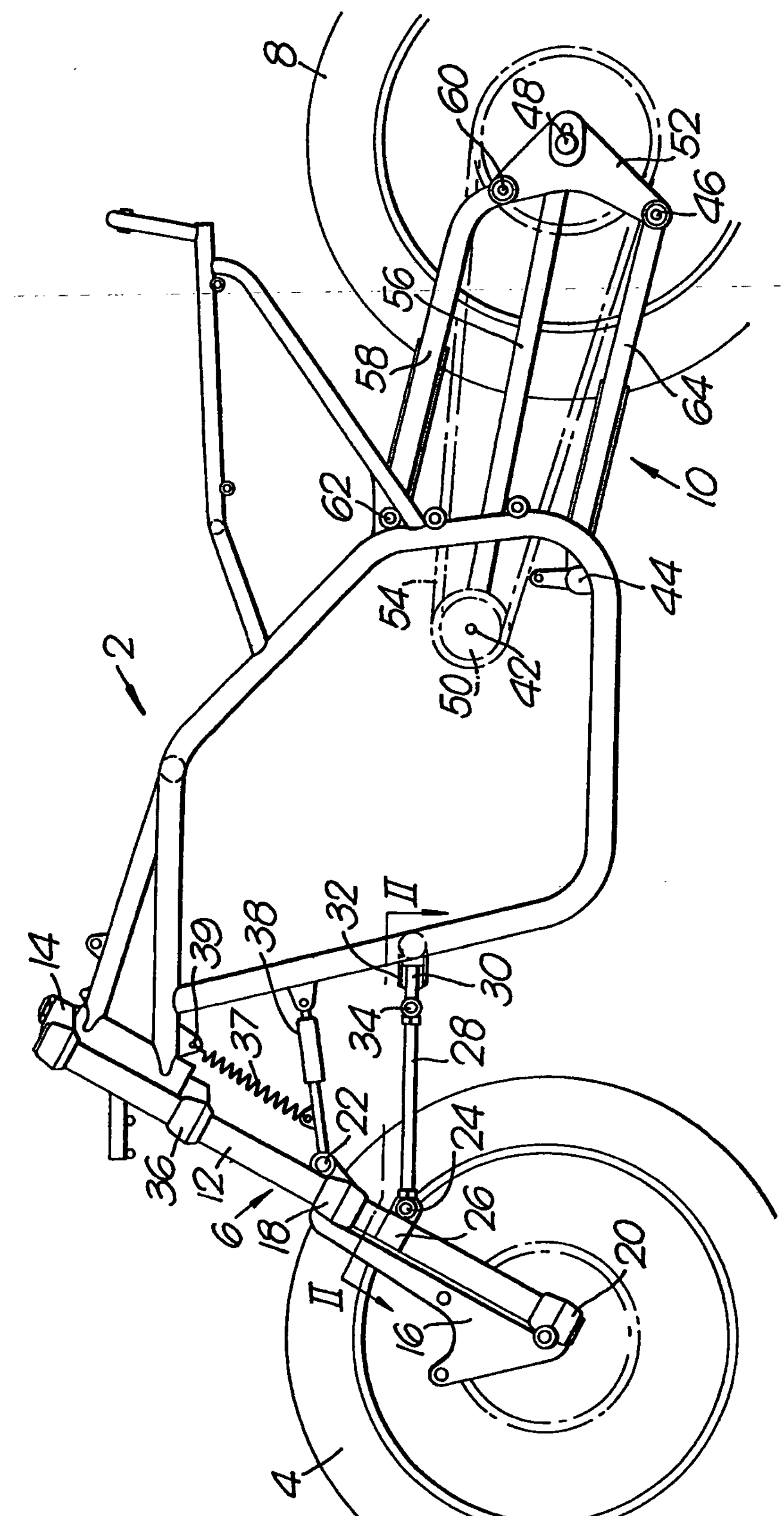
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Fig. 1.

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Fig. 2.

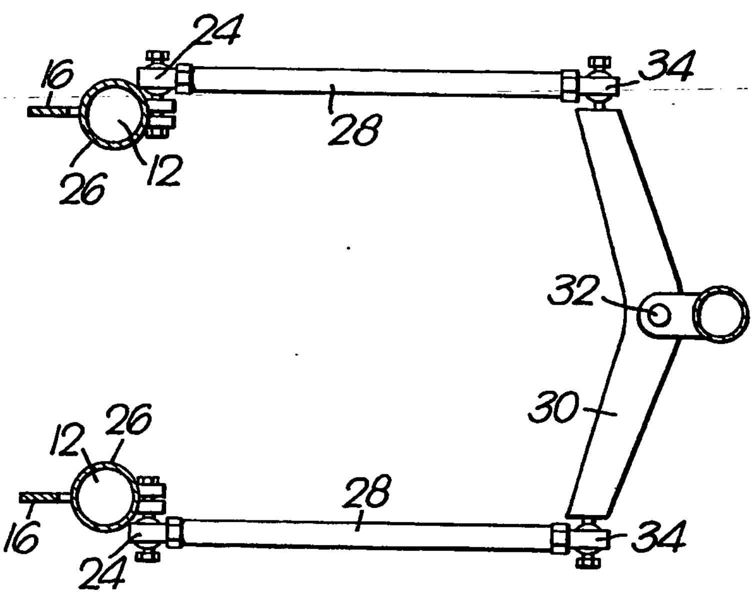
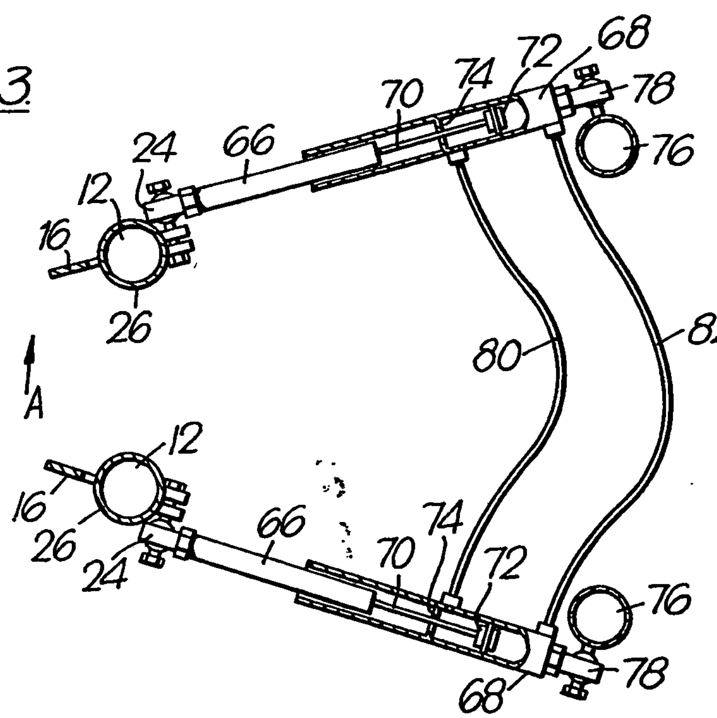


Fig. 3.



SPECIFICATION

Suspension assemblies for motorcycles

This inv ntion relates to motorcycle frames and more particularly to suspension assemblies for the motorcycle wheels.

The front wheel of a motorcycle is normally suspended between the stanchions of front forks which are pivotally secured to the main frame, each stanchion having two telescopically engaged sections which are resiliently movable with respect to one another to cushion the frame and rider as the motorcycle travels over uneven ground and brakes or accelerates. Modern motorcycles are developing such power that this traditional design is no longer sufficiently strong to be reliable, there being insufficient resistance to bending at the telescopic joints at least when the forks are fully extended.

Traditionally, the rear wheel of a motorcycle is suspended on a trailing arm system which is constructed so that the wheel hub moves along a path which follows as closely as possible the arc of a circle about a centre which coincides with that of the drive sprocket. Once again though, the modern motorcycle can develop such power that known rear wheel suspension systems are insufficiently strong to position the wheel correctly at all times with the result that the chain can become dislodged.

According to a first aspect of the present invention, a suspension assembly for the front wheel of a motorcycle comprises a pair of fork stanchions fixed in relation to one another and mounted on a frame for rotation about an axis therein; a slide frame slidably mounted on each stanchion; the slide frames having means for supporting a wheel therebetween; and a bracing rod extending from each stanchion to the main frame, each bracing rod being coupled to the respective stanchion and the main frame by joints permitting universal movement of the rod with respect to the stanchion and the main frame, the arrangement accommodating changes in the spacing between each stanchion and the frame upon rotation of the pair of stanchions relative to the frame. Spring means operatively connected between each slide frame and the respective stanchion may be mounted at either an upper or a lower end of the stanchions.

Changes in the spacing between each stanchion and the frame upon rotation of the forks relative to the frame are, in one embodiment of the invention, accommodated by providing a bell crank pivotally mounted on the frame to which each bracing rod, which is of fixed length, is coupled by a universal joint. This arrangement permits complete freedom of rotational movement of the forks relative to the frame but effectively inhibits bending of the forks towards or away from the frame.

In an th r embodiment, ach bracing rod may be made to be variable in length, such as by comprising a pair of telescopically engaged sections, one of which sections is coupl d to the respective stanchions by a universal joint and the other of which is coupled to the frame by a universal joint, resili nt m ans being provided in ach rod to resist telescopic movement of one section with respect to th other simultan ously in th same sense in both rods. This arrangement will likewise permit complete freedom of rotational movement of the forks relative to the frame while providing a resilient resistance to the forks bending. The resilient means might comprise for example double-acting piston-cylinder mechanisms in the rods, which are interlinked such as to preclude simultaneous compression of the working fluid but permit relative movement of the sections simultaneously in opposite senses.

In an assembly according to the invention, each slide frame is preferably mounted on its respective stanchion by a pair of bearings at a fixed spacing from one another. In this way, the bending forces applied to the forks are always resisted by forces which are spaced the same distance from one another on the stanchions, in contrast to the arrangement in telescopic forks where the spacing between the inner ends of the sections is continually changing.

Each bracing rod is normally coupled to its respective stanchion at a point between the spaced bearings supporting a slide frame, and this coupling may define an upper abutment for the spring means referred to above. The bracing rods and bell crank serve to resist horizontal forces applied between the forks and the main frame, rendering it possible to reduce the weight of the fork stanchions. The universal jointing of the bracing rods permit rotation of the forks with respect to the frame.

According to a second aspect of the invention, a suspension assembly for the rear wheel of a motorcycle comprises a four bar linkage of which a first bar is substantially fixed with respect to the motorcycle frame and has one pivot point substantially on the axis of a drive sprocket of the motorcycle engine, a second bar extends from said one pivot point to a second pivot point on a rear wheel hub support member substantially at the axis of the hub, a third bar is defined within the support member, and a fourth bar from the support member to the other pivot point on the main frame. The assembly may include an additional strut extending from a connection on the hub support member to a pivotal connection on the frame, which strut accommodates the changes in spacing between the connections as a consequence of the four-bar linkage. As the changes in spacing between such connections will not be great, such accommodation may be provided by an eccentric bearing constituting the pivotal connection. Alternatively, the additional strut might take the form of two telescopically engaged sections.

The invention will now be described by way of example and with reference to the accompanying drawings wh rein:—

Figure 1 is a view in elevation of a motorcycle frame showing th principl and preferred f atures of one embodiment f th invention;

The drawings originally filed were informal and th print here reproduced is taken from a later filed formal copy.

Figure 2 is a sectional view taken on th lin II-II of Figure 1; and

Figure 3 is a vi w, similar to Figure 2, of an alternative front suspension assembly arrangement.

Figure 1 shows a motorcycle main frame 2 having a front wheel 4 with an associated suspension assembly 6 and a rear wheel 8 with an associated suspension assembly 10. The front wheel suspension assembly 6 comprises a pair of fork stanchions 12 pivotally supported on an inclined axis in the usual way at 14. However, in contrast to conventional design, each stanchion 12 is a tube of constant length and the wheel is supported thereon by a pair of slide frames 16 attached to the stanchions 12 by sliding Teflon bearings 18, 20 fixed on the slide frames 16. TEFLON is a registered Trade Mark. Between the upper bearings 18, a stabiliser bar 22 xtends to impart rigidity to the structure comprising the two slide frames 16.

The wheel hub and associated equipment such as disc brake calipers are supported on the slide frames 16 in conventional manner and will not be described.

Between the upper 18 and lower bearings 20 on each stanchion 12 is secured a universal or spherical joint 24 by means for example of a ring clamp 26 as shown in Figure 2. A bracing rod 28 extends from each joint 24 to an end of a bell crank 30 which is pivotally supported on the main frame by a plain bearing 32. The joints 34 between the bell crank and the bracing rods are also universal. The bracing rods 28 and bell crank 30 are in common substantially horizontal plane as shown when the front wheel is in the straight ahead position. As the wheel is turned, the inclination of the forks causes the rods to move skew, which movement is accommodated by the universal joints 24 and 34. The bracing rods and bell crank prevent the stanchions 12 from twisting out of their common plane as well as providing resistance to horizontal distorting forces acting on the forks or frame. The spherical joints 24, 34 and the plain journal bearing 32 are lined with Teflon (registered Trade Mark) as the bearings 18 and 20 minimize the need for lubrication.

A coil spring (not shown) may be provided around ach stanchion 12 to impart resilience to the assembly, either between the bearing 20 and the clamp 26 or between the bearing 18 and a bracket 36 adjacent the connection to the main frame 2. Alternatively, or additionally, a telescopically compressible member 38 may be provided which extends from the stabilizer bar 22 to a bracket 40 welded to the main frame 2, a spring 37 extending from the member 38 to a bracket 39 on the frame to provide resilient resistance to upward movement of the slide frames 16. Because the compression of this member 38 is not linear with respect to the movement of the slide frames 16, the cushioning effect varies as the slide frames 16 move. This has th desirable advantage of reducing the rate f increase f th recovery force as the slide frames 16 are forced up th stanchions 12.

The suspension assembly 10 for the rear wheel 8 comprises a four-bar linkage having pivot points 42, 44, 46 and 48. Points 42 and 44 are fixed on the main frame 2, point 42 substantially coinciding with the axis of a drive sprocket 50 for the chain 54. Points 46 and 48 fixed on a hub support member 52, point 48 substantially coinciding with the rear wheel hub axis. The locus of the point 48 is constrained to th arc of a circle by a bar 56, thus nsuring that the driv and driven sprocket spacing is maintained constant and minimizing the danger of the chain 54 becoming dislodged.

Further stability for the assembly 10 is provided by a strut 58 which extends from an upper point 60 on the support member 52 to a point 62 on the main frame 2 to which it is secured by an eccentric bearing. Because the hub axis or pivot point 48 is constrained to move in the arc of a circle about point 42, the distance between points 60 and 62 will not be constant and this movement is taken up by the eccentric bearing. Alternatively, a plain bearing may be used at the point 62 and the strut 58 may be made variable in length by means of telescoping sections. The area 64 between points 44 and 46 is of fixed length.

In a modification of the rear wheel suspension assembly described above, the strut 58 may be made part of the four-bar linkage and the arm 64 provided with the eccentric bearing at point 44 or made variable in length by some other means.

To balance the assembly, three of the member 52, bar 56, strut 58 and arm 64 are duplicated on the opposite side of the rear wheel, not shown. Normally, it is the member 52, strut 58 and arm 64 that are duplicated.

Securement of the bar 56 with respect to the frame 2 is indirect, the drive sprocket (50) arms being of necessity defined relative to the motorcycle engine which is in turn mounted on the frame. On some engines, a bracket can be easily mounted in the appropriate positions on the engine housing.

Spring means for the rear suspension assembly may be included in conventional ways and are not described herein.

Figure 3 shows an alternative bracing rod arrangement. Each bracing rod comprises two telescopically engaged sections 66 and 68. From each section 66 extends a piston rod 70 to a piston 72 in a cylinder defined by section 68. The cylinder is closed by a wall 74 which sealingly engages the rod 70. The piston 72 is thus double-acting in the cylinder. Each section 68 is coupled to main frame members 76 by a universal or spherical joint 78, the joints 24 and 78, together with the telescopic engagement of the sections 66 and 68 permit articulation of the bracing rods with respect to the frame as a consequence of rotation of the forks (12).

As the forks are turned, one bracing rod will be compressed, while the other will be extended. If the forks are bent either towards or away from the main frame members 76, both rods will be either compressed or extended. The arrangement of Figure 3 accommodates turning of the forks but resists bending. This is achieved by filling th cylinders defin d by sections 68 with a working fluid such as oil, and interconnecting th chambers f the cylinders on either side of the pistons 72 by hoses 80 and 82 as shown. Thus, if the forks are turned to the right, as shown by arrow A, il will flow along the hoses 80 and 82 as indicated. On the other hand, if the forks

are bent towards th fram m mbers 76, there will b no flow, but oil in hose 82 will be compress d, and such bending th reby resist d.

The arrangement of Figure 3 provides an improved positional relati nship between the bracing rods (66, 68) and the wheel as the forks are turned without reducing the steering lock. Additionally, it permits the incorporation of a steering damper in the form of a restrictor valve in one of the hoses 80 and 82, preferably the latter. Such a damper may be adjustable. Consequential advantage is that the possibility of fork flexure is reduced by virtue of the lower location of such a damper. Conventional dampers are located near the top of the forks.

CLAIMS

1. A suspension assembly for the front wheel of a motorcycle comprising a pair of fork stanchions fixed in relation to one another and mounted on a frame for rotation about an axis therein; a slide frame slidably mounted on each stanchion; the slide frame having means for supporting a wheel therebetween; and a bracing rod extending from each stanchion to the main frame, each bracing rod being coupled to the respective stanchion and the main frame by joints permitting universal movement of the rod with respect to both the stanchion and the main frame, the arrangement accommodating changes in the spacing between each stanchion and the frame upon rotation of the pair of stanchions relative to the frame.

2. An assembly according to Claim 1 wherein each bracing rod is of fixed length and coupled to the respective stanchion by a universal joint and to the frame by means of a bell crank pivotally mounted on the frame, a universal joint being provided between each bracing rod and the bell crank.

3. An assembly according to Claim 1 wherein ach bracing rod comprises a pair of telescopically engaged sections, one of which sections is coupled to the respective stanchion by a universal joint and the other of which is coupled to the frame by a universal joint, resilient means being provided in each rod to resist telescopic movement of one section with respect to the other simultaneously in the same sense in both rods.

4. An assembly according to Claim 3 wherein the resilient means comprises interlinked piston-cylinder mechanisms.

5. An assembly according to any preceding Claim wherein each bracing rod is coupled to its respective stanchion at a point between the spaced bearings supporting a slide frame.

6. An assembly according to any preceding Claim wherein each slide frame is mounted on its respective stanchion by a pair of bearings at a fixed spacing from one another.

7. An assembly according to Claim 6 wherein the bearings are fixed on the slide fram .

8. An assembly according to any preceding Claim including a stabiliz r rod ext nding betw n the slid fram s.

9. An assembly according to any preceding Claim including at l ast on telescopic link xtending from the pair of stanchions to the frame at a first level and a resiliently compressible suspension lement ext nding upwards from the link to the frame at a second lev l.

10. An assembly according t Claim 8 and Claim 9 wherein said at least on link extends from the stabiliser rod.

11. A suspension assembly for the front wheel of a motorcycle substantially as described herein with reference to and as illustrated by the accompanying drawings.

12. A suspension assembly for the rear wheel of a motorcycle comprising a four-bar linkage of which a first bar is substantially fixed with respect to the motorcycle frame and has one point substantially on the axis of a drive sprocket of the motorcycle engine, a second bar extends from said one pivot point to a second pivot point on a rear wheel hub support member substantially at the axis of the hub, a third bar is defined within the support member, and a fourth bar from the support member to the other pivot point on the main frame.

13. An assembly according to Claim 12 including an additional strut extending from a connection on the hub support member to a pivotal connection on the frame, which strut accommodates the changes in spacing between the connections as a consequence of the four-bar linkage.

14. An assembly according to Claim 13 wherein said accommodation is provided by an eccentric bearing constituting the pivotal connection.

15. A suspension assembly for the rear wheel of a motorcycle substantially as described herein with reference to and as illustrated by the accompanying drawings.

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